

# Perceived Benefits of a Therapeutic Exercise Program through Digital Interactive Games Among Children with Cancer

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**Αντιληπτά Οφέλη  
που Σχετίζονται με τη Συμμετοχή  
σε ένα Θεραπευτικό Πρόγραμμα  
Άσκησης μέσω Ψηφιακών  
Διαδραστικών Παιχνιδιών  
σε Παιδιά με Καρκίνο**

*Abstract at the end of the article*

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**Introduction:** Clinical treatments against cancer disease, contribute decisively to the deterioration of physical and mental well-being of pediatric oncology patients, however exercise has been proposed as a safe, non-pharmacological intervention strategy for pediatric populations suffering from chronic diseases, which affects positively the quality of life of patients. **Purpose:** The purpose of this study was to identify perceived benefits associated with participation in a therapeutic exercise program through digital interactive games among children who have been diagnosed with cancer. **Material and Method:** A total of six children, aged from five to nine years old, boys and girls, who were staying at the hostel of the Association of Friends of Children with Cancer "Storgi" in Thessaloniki, participated in a 12-week therapeutic exercise program, with the use of the Xbox Kinect™ console. The frequency of attendance was 3 times per week, while the duration of each training session was set at 30 minutes. Data were collected using a combination of observations and individual interviews with the children, one of their parents and a staff member of the hostel. **Results:** From the qualitative data analysis four major themes were aroused: (a) enhancement of social skills, (b) decreased cancer related fatigue, (c) positive emotions, (d) control of negative feelings. **Conclusions:** The involvement of cancer patients in a therapeutic exercise program that combines exercise with digital interactive games plays a vital role in strengthening the child's social skills, reducing the perceived fatigue, enhancing positive emotions, as well as decreasing the negative psychological effects due to cancer treatment.

**Key-words:** Exercise, pediatric oncology, cancer, exergames, therapeutic exercise.

## Introduction

The diagnosis of childhood cancer is a dramatic event that contributes decisively in the later life of children and their families,<sup>1</sup> however, compared to adults, the possibility of developing cancer during childhood is reduced. Clinical therapies against cancer have been shown to contribute to the deterioration of physical and mental well-being of children who have been diagnosed with cancer. They experience fatigue and burnout,<sup>2</sup> they have decreased cardiovascular and respiratory functions, cachexia,<sup>3</sup> eating disorders, insomnia,<sup>4</sup> nausea, vomiting<sup>5</sup> and pain.<sup>6</sup> Additionally, some of the most common psychosocial consequences experienced by individuals are depression,<sup>7</sup> anxiety, stress,<sup>8</sup> reduced self-esteem<sup>9</sup> and social isolation.<sup>10</sup> Furthermore, these symptoms do not only occur during therapy but is possible to continue for months or, even, years after treatment.<sup>11</sup>

The positive effects of exercise as a non-pharmaceutical intervention was considered, for the first time as a possible parallel reinforcement, during treatment for cancer patients and survivors in the mid-1980s.<sup>12</sup> Nowadays, it is widely accepted that physical exercise is an intervention strategy that is able to enhance the quality of life of the patients, both during and after the treatment,<sup>13-15</sup> while, at the same time, it is considered that physical exercise reduces the rate of development of the disease,<sup>16</sup> as well as increases the life expectancy of the patients.<sup>16</sup> Furthermore, earliest evidence from a small number of studies have shown that exercise has the potential to increase cardiopulmonary fitness, it improves muscle strength and flexibility, reduces fatigue, improves physical function,<sup>17</sup> decreases feeling of stress, fear and anxiety, while increases positive emotions and enhances sleep efficacy.<sup>18</sup>

Regardless of the fact that the existing literature on the involvement of pediatric oncology populations in exercise is not so extensive, the evidence we have to date suggests that it is necessary for children to follow an active lifestyle in order to reduce negative psychosomatic complications by incorporating exercise into their daily lives. However, despite the benefits of participating in organized exercise programs, even after the end of the treatment, the majority of children tend to abstain from physical activity, while exhibiting significantly lower levels of physical activity than their peers, and, also, follow an unhealthy lifestyle which is characterized by sedentary behavior.<sup>19</sup>

Regarding the recommendations for the involvement of pediatric oncology populations in organized exercise programs, the views in the field of research are ambiguous

because there is still no agreement on the type of exercise, duration of the intervention program, frequency of participation, intensity and duration of participation per training unit.<sup>20</sup> Nevertheless, recently published meta-analysis studies indicate that the most appropriate exercise for pediatric oncology patients should be characterized by low to moderate heart rate intensity.<sup>17,21</sup>

Based on the above findings and in point of the perceived benefits of exercise, the digital interactive exercise games or the well-known "exergames" provide an innovative and, at the same time, enjoyable type of physical activity. "Exergaming" is a term which consists of the combination of words, exercise and game, and is used to define video games that promote physical activity.<sup>22</sup>

In the past, many researchers have argued that exercise through digital interactive games: (a) has a positive effect on maintaining health and fitness levels of the participants, (b) is an enjoyable kind of physical activity, (c) is characterized as user-friendly device, (d) promotes socialization and, finally, (e) enhances the participants' engagement in exercise programs both in clinical and healthy populations.<sup>23-26</sup>

## Aim

Given that exercise is beneficial and that exercise through digital interactive games is a pleasant way of training, this study aimed to identify the perceived benefits, associated with participation in a therapeutic exercise program through digital interactive games among children, who have been diagnosed with cancer.

## Material and Method

The selection of the participants in the present study was purposeful.<sup>27</sup> A total of six pediatric oncology patients, aged from five to nine years old, boys and girls, who had been diagnosed with cancer and were staying at the hostel of the Association of Friends of Children with Cancer "Storgi" of Thessaloniki in Greece, were recruited. Participants' characteristics are analytically presented in table 1.

During the 12-week period the main data collection instrument was the researcher herself (1st author), as she was observing and keeping detailed notes in a field diary about the intervention program, events, and discussions.<sup>28</sup>

In order to examine the perceived benefits of the therapeutic exercise program through digital interac-

**Table 1.** Characteristics of the participants.

Gender	Age (years)	Type of cancer
Female	5	Acute Lymphoblastic Leukemia
Male	5	Retinoblastoma
Female	6	Acute Myeloid Leukemia
Female	6	Acute Myeloid Leukemia
Female	9	Hodgkin's Lymphoma
Male	9	Nasopharyngeal Carcinoma

tive games, interviews were conducted with the children (N=6), with one of the parents of each child (N=6) and a staff member of the hostel for a total of 30–40 minutes. The interviews were conducted twice, in the middle (after the 6th week) and after the end of the interventional exercise program through digital interactive games. The interviewer (1st author) asked each respondent the same series of open-ended questions, which were created prior to the interview. Questions explored current exercise behaviors and perceived benefits to exercise. At the end of each interview, a copy of the written text of the interview was given to each participant to read it carefully and sign it except from the child in purpose to enhance the trustworthiness of the interviews. Finally, it is necessary to add that all field notes of the observations which contained some informal discussions out of the exercise program and discussions with the staff of the hostel, clarified the researchers' worries about the honesty of the participants' answers, enhancing with this way the reliability of our findings.

A bilateral agreement dealing with ethical procedures between the researchers and the President of the Association of Friends of Children with Cancer "Storgi" was signed. The permission allowed only one of the researchers to enter the facilities of the hostel. Before the children's participation, the parents were informed about the aim and the design of the study and they signed a written informed consent. All measurements were performed at the hostel of the Association of Friends of Children with Cancer "Storgi" of Thessaloniki in Greece. Moreover, approval was obtained from the Ethics Committee (EC) of Democritus University of Thrace (DUTH).

Prior to the exercise program with digital interactive games medical history was completed in order to collect information about the patients and their family environment. The program lasted a total of 12 weeks. Prior to intervention, the participants received an introductory

tutorial on how to use the Xbox 360 Kinect console and its peripheral devices. Frequency of attendance was 3 times per week, while duration was thirty minutes per training session. The digital interactive games series "Kinect sports", "Kinect sports-season 2" and "Kinect Adventures" were used. The participants had their own Mii character (virtual self), which had created according to the appearance that they would like to have. The children didn't refer any prior participation in physical activity before the exercise program with digital interactive games during the cancer treatment.

In the social sciences, triangulation is often used to indicate that two or more methods are used in a study in order to check the results of one same subject.<sup>29</sup> So based on the above, in order to strengthen the validity of our findings, we tried to collect data through interviews (children, parents, member staff of the hostel) and observations (before, during and after the exercise program), with the purpose to obtain the same results from each research technique, so we could become sure that the data are valid.

### Qualitative analysis

In the present study for the assessment of the qualitative data, interviews were transcribed verbatim and analyzed using thematic analysis.<sup>30</sup> Data analysis was conducted as collaborative negotiations between the researchers. In the beginning, all researchers read the transcripts and the text of observations in order to get an overall impression. In second phase, they identified and coded units of meaning representing participants' perceived experiences of interventional program with digital interactive games. Then, they grouped all the coded data under greater categories, and compared them with the original. After this, they summarized the contents of each group to generalize the descriptions regarding the participants' experiences. Finally, all authors discussed the coded data and agreed on the themes.<sup>30</sup>

### Results

From the qualitative data analysis the following four major themes were conducted: (a) enhancement of social skills, (b) decreased cancer-related fatigue, (c) positive emotions, (d) control of negative feelings. Respondents' beliefs regarding their participation in the therapeutic exercise program through digital interactive games can be summarized as follows:

### 1st Theme - Enhancement of social skills

*Children:* "Together we're invincible (smiling)", "We win all the points (during the exercise through digital interactive games)", "It's nice that we played together", "We are friends".

*Parents:* "Through exercising with digital interactive games he/she came in contact with all the other children who were staying at the hostel", "(Exercise through digital interactive games) is a way to communicate and collaborate".

*Staff member:* "They developed feelings of socialization, communication with other children - a common positive point of reference - discussion among them - apart from the illness issues", "He/She smiles", "He/She wants to meet each one (during his/her daily routine) of the hostel's staff members", "He/She meets them in their office, after the program with...(Smiling)", "It was very good for him/her", "He/She developed another social relationship with all the other children and families hosted", "When parents accompanied their children to the exercise program, they interacted with all the other families, the staff, and the people who were visiting us", "...a relationship based on trustworthiness was created".

### 2nd Theme - Decreased cancer-related fatigue

*Children:* "I do not feel tired", "I am very strong".

*Parents:* "The program boosts his/her energy because...", "He/She was active and not lying all day in bed", "He/She doesn't mention pain, he/she sleeps quite well, eats normally", "He/She doesn't have loss of appetite", "He/she does not complain about any cancer treatment-related symptoms".

*Staff member:* "Digital interactive exercise games offered them a sense of strength, vitality and energy", "They had the energy to continue playing", "After the end of each training session, we observed in all children strong willingness to participate and increased their physical activity during the day".

### 3rd Theme - Positive emotions

*Children:* "I, really, enjoy these games", "It's perfect!", "I want to play all the time!", "It's like a party!", "I spend a great time here", "I want to stay here", "I do not want to return to my room", "This game is very funny", "I'm happy when I come here", "It's exciting (dancing and clapping hands)", "It does not matter that I, sometimes, lose during the game", "I'll do my best!", "I will do it!", "We do not

give up", "We will win!", "Step by step", "Yes, I did it!", "Every time, I win even more points", "I am a very good player", "I can win this round", "I can do it!", "I believe that I can do it!", "I did it!".

*Parents:* "When he/she wakes up, the first thing that he/she wants is to play digital interactive games", "He's/She's hurrying to play", "He's/She's very happy to get out of our house and come here", "He/She, always, smiles, when he/she talks about these games", "He/She is more optimistic", "He/She does not think about his/her illness", "He/She expects to play the next day", "He/She doesn't ask anymore what is going to happen the next day in his/her life", "He/She feels that he/she can do many things", "His/Her illness does not stop him/her from participating in this exercise program".

*Staff member:* "They feel joy and enthusiasm", "They expressed the desire to participate more in digital interactive games", "Concerning the effects of this type of exercise, we estimate that children's engagement in digital interactive exercise games, during their cancer treatment and during their stay at the hostel, will be a positive experience and a relief from the cancer-related symptoms", "We appreciate that, apart from entertainment, it (the exercise program through digital interactive games) gives children a feeling of creativity and optimism", "It makes them feel important, and that they can achieve things in their life", "It gives children a sense of self-worth", "It (exercise through digital interactive games) gives them an alternative perspective in order to adapt to the new conditions of their lives".

### 4th Theme - Control of negative feelings

*Children:* "No, I'm not worried at all", "I'm fine, especially, when I participate in skiing (digital interactive game)", "I do not care about anything", "You know..., I did not expect to say that..., but I feel better now without my hair...", "(My hair) is not falling anymore into my face (during the game)", "I can play better now", "I'm not sad".

*Parents:* "Throughout the program, he/she never told us that he/she was stressed", "He/She was calmer in comparison to the period before the beginning of the program ...with more patience and less outbursts, anger and anxiety".

*Staff member:* "(The therapeutic exercise program through digital interactive games) helped children to forget their health problems, and decreased their perceived negative feelings like anxiety and stress".

## Discussion

In the present study, individual interviews and observations were conducted by the first author in order to classify perceived benefits associated with the participation of children, who had been diagnosed with cancer, in a 12-week therapeutic exercise program through digital interactive games. Based on the qualitative data analysis, four major themes emerged: (a) enhancement of social skills, (b) decreased cancer-related fatigue, (c) positive emotions, (d) control of negative feelings.

Concerning the parameter "enhancement of social skills", the responders' answers showed that, through their participation in the therapeutic exercise program, the patients acquired new social skills like communication and collaboration. These findings are in agreement with the results of previous studies, which have shown that regular participation in physical exercise contributes decisively to the improvement of social functioning of pediatric oncology patients by decreasing social isolation, as the participants meet new people, make new friends and have social interaction with others.<sup>26,31</sup>

Another important finding, which emerged, was "decreased cancer-related fatigue". Results indicated that, through their participation in this exercise program, patients did not experience any fatigue and burnout. Particularly, as it has been shown by both children themselves and their social environment, they did not feel tired and did not mention any cancer treatment-related symptoms such as pain, sleep disorders or anorexia. Additionally, digital interactive exercise games offered them a sense of strength, vitality and boosted energy by giving them the willingness to increase their physical activity levels during the day. The above findings are in agreement with those of previous studies, which have reported that exercise interventions among children with cancer have a positive effect on reducing the children's perceived fatigue during the phase of treatment,<sup>32,33</sup> as well as during survivorship.<sup>34</sup>

"Positive emotions" and "Control of negative feelings" were, also, cited as major 'barriers'. From all points of view, the children's participation in exercises through digital interactive games gave children the opportunity to have fun, feel pleasure, happiness and enjoyment, and increase their enthusiasm during their daily routine at the hostel. Above all, the perceived negative feelings like anxiety and stress, which were experienced by the participants before the beginning of the training program, were significantly low. These findings concur with the results of previous studies, which have shown that engagement of pediatric oncology

patients in exercise programs aims at enhancing both psychological parameters, assisting the children in adopting to the new conditions of their life.<sup>12,15,26</sup> Additionally, the secretion of endorphins during the exercise increases the feeling of positive emotions, while decreases the negative feelings, such as intense anger and stress, and, as a result, leads to a sense of euphoria and happiness.<sup>35</sup>

Based on the results of the current study and the findings of previous research, there is agreement that the engagement of children with cancer in interventional exercise programs enhances children's overall quality of life,<sup>12-15</sup> reduces fatigue, as well as improves the perceived physical function.<sup>17</sup> Most significantly, regarding the psychosocial benefits, it is generally accepted that exercise decreases the feeling of stress, fear, social isolation, depression and anxiety.<sup>18,26</sup>

## Limitations

It is important to note that our small sample and lack of previous studies in this area could be the limitations of the present study.

## Conclusions-Suggestions

In conclusion, regarding perceived benefits associated with participation in a 12-week therapeutic exercise program through digital interactive games among children, who had been diagnosed with cancer, our findings indicated that the incorporation of this kind of physical activity, during the phase of cancer treatment, plays a vital role in: (a) enhancing social skills and positive emotions, (b) decreasing cancer-related fatigue, and (c) controlling negative feelings. Exercise through digital interactive games has to be incorporated as a therapeutic type of parallel treatment into the organizations, which host children with cancer, enabling by this way children to be more active and exercised in safe environment under the supervision and monitoring of a specialized trainer, taking into consideration the unique needs, the type of cancer and stage of the disease of each participant.

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## ΠΕΡΙΛΗΨΗ

## Αντιληπτά Οφέλη που Σχετίζονται με τη Συμμετοχή σε ένα Θεραπευτικό Πρόγραμμα Άσκησης μέσω Ψηφιακών Διαδραστικών Παιχνιδιών σε Παιδιά με Καρκίνο

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**Εισαγωγή:** Οι κλινικές θεραπείες ενάντια στη νόσο του καρκίνου, συντελούν στην επιδείνωση της σωματικής και πνευματικής ευημερίας των παιδιατρικών ογκολογικών ασθενών, ωστόσο η άσκηση έχει κατά καιρούς προταθεί ως μία ασφαλής, μη φαρμακευτική στρατηγική παρέμβασης για τους παιδιατρικούς πληθυσμούς που πάσχουν από χρόνιες ασθένειες, η οποία επιδρά θετικά στην ποιότητα ζωής των ασθενών. **Σκοπός:** Να προσδιοριστούν τα αντιληπτά οφέλη που σχετίζονται με τη συμμετοχή σε ένα θεραπευτικό πρόγραμμα άσκησης μέσω ψηφιακών διαδραστικών παιχνιδιών σε παιδιά που έχουν διαγνωστεί με καρκίνο. **Υλικό και Μέθοδος:** Συνολικά έξι παιδιά, ηλικίας 5 έως 9 ετών, αγόρια και κορίτσια, που διέμεναν στον ξενώνα του Συλλόγου Φίλων των Καρκινοπαθών Παιδιών «Στοργή» στη Θεσσαλονίκη, συμμετείχαν σε ένα θεραπευτικό πρόγραμμα άσκησης διάρκειας 12 εβδομάδων, χρησιμοποιώντας την κονσόλα Xbox Kinect™. Η συχνότητα συμμετοχής ήταν 3 φορές την εβδομάδα, ενώ η διάρκεια συμμετοχής ανά προπονητική μονάδα ορίστηκε στα 30 λεπτά. Τα δεδομένα συλλέχθηκαν μέσω παρατηρήσεων και ατομικών συνεντεύξεων με τα παιδιά, με έναν από τους γονείς τους και με έναν υπάλληλο του ξενώνα. **Αποτελέσματα:** Από την ανάλυση των ποιοτικών δεδομένων προέκυψαν τέσσερα κύρια θέματα: (α) η ενίσχυση των κοινωνικών δεξιοτήτων, (β) η μείωση της κόπωσης που σχετίζεται με τον καρκίνο, (γ) τα θετικά συναισθήματα, (δ) ο έλεγχος των αρνητικών συναισθημάτων. **Συμπεράσματα:** Η συμμετοχή των παιδιών με καρκίνο σε ένα θεραπευτικό πρόγραμμα άσκησης που συνδυάζει την άσκηση με το παιχνίδι διαδραματίζει καθοριστικό ρόλο για την ενίσχυση των κοινωνικών δεξιοτήτων των παιδιών, τη μείωση της αντιληπτής κόπωσης, την ενίσχυση των θετικών συναισθημάτων, καθώς και τη μείωση των αρνητικών ψυχολογικών επιπτώσεων εξαιτίας της θεραπείας του καρκίνου.

**Λέξεις-ευρητήριο:** Άσκηση, παιδιατρική ογκολογία, καρκίνος, ψηφιακά διαδραστικά παιχνίδια άσκησης, θεραπευτική άσκηση.

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